GEOLOGY OF UTAH AND NEVADA BY ERTS IMAGERY

Proposal # 307

M. L. Jensen, GSFC ID No. UN 113

Department of Geological and Geophysical Sciences

University of Utah

Salt Lake City, Utah 84112

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Objective of the Contract

The objective of the contract is to evaluate the utility of satellite imagery in the study of geological structures and features and in the exploration for potential economic mineral deposits.

2. RESEARCH

2.1 Work Performed

2.1.1 Summary of work performed during the reporting period.

Imagery for most of the study area has been received, with most of the area having been covered on several passes of the satellite. The central portion of the study area is not represented in the received imagery as often as the eastern and western extremities of the area.

Contact prints have been used to compile mosaics of the study area. Overlays are then prepared which delineate features of interest. These data are then compared against available maps and other data to ascertain which features are known, and which may be new. From these comparisons are derived schedules of areas to be covered in field checking.

A simple method of producing color composites and single-color band-images has been learned. This involves the use of Diazochrome color films in an Ozalid contact copier. The method is rapid, simple, and relatively inexpensive. The superposed films result in a color transparency which can be re-photographed by 35 mm or other cameras to produce excellent projection materials. The superposed films can be used directly on overhead projectors.

(For significant results section)

Section 2.1.2

Two ancient watercourses have been observed on ERTS 1 imagery. These lie in the Waterpocket Fold area, north of the Marble Canyon section of the Colorado River, in Arizona and Utah. The old watercourse appears to have been northward flowing, following the Waterpocket Fold west of the Henry Mountains, across the present Fremont River drainage and east of the San Rafael Swell. The Fremont River and other drainages have captured portions of the system. The watercourse can be observed on image no. 1032-17370. A cutoff meander on the Colorado River, still above the present level of Lake Powell, appears to be of similar age and possibly related to the ancient watercourse. The major part of the path of the watercourse appears to be structurally controlled.

A second old watercourse can best be seen in the vicinity of Long Ridge and the San Juan River on image no. 1031-17313.

A third old watercourse of some interest is an ancient canyon of the Colorado, located at about 38°45' N, 108°45' W on image no. 1156-17260. The area was uplifted after the canyon was cut, and the stream diverted to the northwest. There are a number of plainly visible faults in this area which have not yet been noted in the published literature, although the area is not strictly in the study area of this contract, and ground truth has not been completely compiled for the area.

(For significant results section)

Image no. 1051-17414 contains some very useful information concerning the hydrology, sedimentology and biology of Great Salt Lake and Bear Lake in Utah. The greater penetration of wavelengths in band 4 of the MSS imagery yields much information about sediment plumes and water depth. Band 5, with lesser penetration, gives more information about surface phenomena, including algal populations, etc. The infrared bands provide information about shallow water in marsh areas where the water is hidden from shorter-wavelength bands by vegetation. In Great Salt Lake, there is a sharp line between the portion of the lake north of the railroad causeway and that south of the causeway. There is a marked difference in salinity across the causeway, and this is reflected in different algal species, plainly visible in band 5. A reddish algae occupy the north limb, while blue-green varieties occupy the south limb. The negative water budget in the north limb causes brine concentration in that area, accompanied by northward surface flow through the two narrow openings in the causeway. This flow can be seen in band 5. The high density in the northern limb results in density-current counterflow at depths, and this can be seen in band 4. The sediment plumes from inflowing rivers are plainly visible on bands 4 and 5.

On the same image, sediment plumes in Bear Lake clearly delineate the circulation pattern, and provide excellent indications of bottom contours over much of the area. The band-7 image clearly outlines the march areas at the north end of the lake, which are hidden by vegetation from bands 4 and 5.

Image no. 1051-17420 contains part of Great Salt Lake and all of Utah Lake. The latter displays a very interesting surface pattern which is probably due to an algal bloom which has been swirled into a spiral by the circulation of the lake. This was a short-lived phenomenon which has not been observed on other imagery to date. The algal nature of the phenomenon is not yet proven.

2.1.3 Efforts to Achieve Reliability

The reliability of inferences drawn from ERTS imagery can only be established by field work and close comparison with varyous forms of ground truth. Field work has been limited by weather and snow cover to date, but checks against geological and geophysical data are made routinely, where such other data are available.

2.1.4 Publications

No publication of data or results took place during the reporting period.

2.1.5 Conformance to Work Schedule

The slow arrival of early imagery caused the project to be somewhat behind schedule during the previous reporting period, but the methods of data handling developed during that period have been very effective in keeping the project abreast of the large inflow of imagery during the present period. The project is now on schedule.

2.1.6 Work Progress

The progress of work is deemed satisfactory during the reporting period.

2.2 Work Planned for the Next Reporting Period

2.2.1 Summary

The work for the next period will follow the pattern of the present period, with very slight modifications. More efficient data-handling methods are continually evolving, and the development of a process for producing color imagery with relative ease (see sec. 2.1.1) will expedite image interpretation. Ameliorating weather conditions will permit initiation of field checking of the large quantity of features observed in the imagery.

The observation that a number of faults can be traced from exposed rock into alluvial areas on the ERTS images has

prompted the decision to include Induced-Polarization and Soil-Gas studies of the areas in the alluvium into which the lineations extend. Since many of the observed faults are in mineralized areas, the establishment of the validity of the ERTS-imagery interpretations would provide a very rapid and economical method of locating new areas of economic-mineral potential.

2.2.2 Recommendations for Changes in Operations

No basic changes in operation are contemplated at the present time, other than the addition of Induced-Polarization and Soil-Gas analyses to the planned field work in some areas, as noted above.

3. MANAGEMENT

3.1 Problems

It is becoming increasingly apparent that the quantity of new features to be observed on the ERTS imagery is so great that there cannot be a complete investigation of all, or even a major portion of, these features. Only the ones holding the greatest potential for economic exploitation will be looked at under the present contract. The acquired imagery and catalog of features will provide a valuable resource for further investigations, and it can only be hoped that support for the necessary field work can somehow be obtained later.

3.2 Adequacy of Funds

The project funding is less than optimum. Compromises in personnel and field work will have to be made.

3.3 Changes in Standing-Order Forms

None.

3.4 Changes in Personnel

Due to insufficient funds, Dr. Grey will cease to be employed on the project after February 24, 1973.

3.5 Data Request Forms

None.

3.6 Image Descriptors

Standard Image Descriptor forms are supplied herewith for all imagery received during the reporting period.